

# **Common Sensor Data Record Science Processing Algorithm (C-SDR\_SPA) User's Guide**

**Version 2.4**

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**GODDARD SPACE FLIGHT CENTER  
GREENBELT, MARYLAND**

# **Common Sensor Data Record Science Processing Algorithm**

## **C-SDR\_SPA**

### **General**

The NASA Goddard Space Flight Center's (GSFC) Direct Readout Laboratory (DRL), Code 606.3 developed this software for the International Polar Orbiter Processing Package (IPOPP). IPOPP maximizes the utility of Earth science data for making real-time decisions by giving fast access to instrument data and derivative products from the Suomi National Polar-orbiting Partnership (SNPP), Aqua and Terra missions, and the Joint Polar Satellite System (JPSS-1) mission.

Users must agree to all terms and conditions in the Software Usage Agreement on the DRL Web Portal before downloading this software.

Software and documentation published on the DRL Web Portal may occasionally be updated or modified. The most current versions of DRL software are available at the DRL Web Portal:

<https://directreadout.sci.gsfc.nasa.gov/?id=software>

Questions relating to the contents or status of this software and its documentation should be addressed to the DRL via the Contact DRL mechanism at the DRL Web Portal:

<https://directreadout.sci.gsfc.nasa.gov/?id=dspContent&cid=66>

### **Algorithm Wrapper Concept**

The DRL has developed an algorithm wrapper to provide a common command and execution interface to encapsulate multi-discipline, multi-mission science processing algorithms. The wrapper also provides a structured, standardized technique for packaging new or updated algorithms with minimal effort.

A Science Processing Algorithm (SPA) is defined as a wrapper and its contained algorithm. SPAs will function in a standalone, cross-platform environment to serve the needs of the broad Direct Readout community. Detailed information about SPAs and other DRL technologies is available at the DRL Web Portal.

### **Software Description**

This software package contains the Common Sensor Data Record Science Processing Algorithm (C-SDR\_SPA). The C-SDR\_SPA software package processes SNPP and Joint JPSS-1 Visible Infrared Imaging Radiometer Suite (VIIRS), Advanced Technology Microwave Sounder (ATMS), and Cross-track Infrared Sounder (CrIS) Raw Data Record (RDR) HDF5 products into corresponding instrument-specific and mission-compliant HDF5 Sensor Data Record (SDR) and Geolocation swath products. The SPA functions in two modes: standalone, or as an IPOPP plug-in (IPOPP v2.6 or later required).

## **Software Version**

Version 2.4 of the DRL algorithm wrapper was used to package the SPA described in this document. The C-SDR\_SPA package contains the Block 2.0 Interface Data Processing Segment (IDPS) Algorithm Development Library (ADL) Software with Direct-Readout (DRO) extensions. The IDPS ADL Software leverages the following versions of the IDPS Operation System (OPS) Software:

- a) VIIRS SDR - ADL 5.3.16, IDPS I2.0.03.01 baseline;
- b) CrIS SDR - ADL 5.3.16, IDPS I2.0.03.01 baseline;
- c) CrIS Full Spectral (FS) SDR - ADL 5.3.16, IDPS I2.0.03.01 baseline;
- d) ATMS SDR - ADL 5.3.16, IDPS I2.0.03.01 baseline.

The Block 2.0 IDPS ADL software contained in the C-SDR\_SPA package has been extended and specialized with additional code. The additional code, collectively referred to as DRO, is an implementation of SNPP and JPSS-1 algorithm support using SNPP and JPSS-1 ADL packaging for standalone use in a Direct Readout environment.

Enhancements to this SPA include:

- Updated algorithms to Block 2.0 ADL 5.3.16, IDPS I2.0.03.01 baseline, with Direct Readout (DRO) extensions applied.
- Implementation of JPSS-1 support; namely, JPSS-1 versions of existing SPA services (JPSS-1\_VIIRS\_C-SDR, JPSS-1\_ATMS\_C-SDR, and JPSS-1\_CRIS\_C-SDR).
- Implementation of the CrIS Full Spectral (FS) SDR algorithm for both SNPP and JPSS-1, including the addition of new SPA services (SNPP\_C-SDR\_CRIS-FS and JPSS-1\_C-SDR\_CRIS-FS).
- Parallel processing to enable multiple instances of VIIRS SDR to reduce latency (IPOPP v2.6 or later required).
- Fully autonomous Look-up Table (LUT) retrievers.
- Updated test data and scripts, which now include test scripts for cross-granule RDR inputs for VIIRS SDR, and test scripts for JPSS-1 ATMS, CrIS, CrIS FS, and VIIRS SDR algorithms.

This software will execute on a 64-bit computer. This software has been tested on a computer with 64GB of RAM and a CentOS Linux 7 x86\_64 operating system.

**NOTE:** C-SDR\_SPA requires CentOS Linux 7 or later.

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## **Credits**

The Direct Readout SDR algorithms within C-SDR\_SPA were provided to the DRL by the JPSS Ground Project.

## **Prerequisites**

To run this package, you must have the Java Development Kit (JDK) or Java Runtime Engine (JRE) (Java 1.6.0\_25 or higher) installed on your computer, and have the Java installation bin/ subdirectory in your PATH environment variable. This package contains 64-bit binaries statically pre-compiled on an x86-compatible 64-bit computer running under CentOS 7, using gcc 4.8.

## **Program Inputs and Outputs**

This SPA includes SDR algorithms for the SNPP and JPSS-1 VIIRS, CrIS (normal and full spectral resolutions), and ATMS instruments.

The VIIRS SDR algorithm takes a VIIRS RDR file (containing a VIIRS Science RDR and a Spacecraft Diary RDR) and required ancillaries as input and outputs the VIIRS Imagery resolution SDRs, VIIRS Moderate resolution SDRs, the VIIRS Day/Night Band (DNB) SDR, the VIIRS On Board Calibrator Intermediate Product (IP), the VIIRS Calibrated Dual Gain IP, and the VIIRS Geolocation products.

The ATMS SDR algorithm takes an ATMS RDR file (containing an ATMS Science RDR and a Spacecraft Diary RDR) and required ancillaries as input and outputs the ATMS SDR, the ATMS Temperature Data Record (TDR), and the ATMS Geolocation products.

The CrIS SDR algorithm takes a CrIS RDR file (containing a CrIS Science RDR and a Spacecraft Diary RDR) and required ancillaries as input and outputs the CrIS SDR and Geolocation products.

Additionally, the CrIS FS SDR algorithm takes a CrIS RDR file (containing a CrIS Science RDR and a Spacecraft Diary RDR) and required ancillaries as input and outputs the CrIS FS SDR and Geolocation products.

## **Installation and Configuration**

### **Installing as a Standalone Application:**

Download the C-SDR\_2.4\_SPA\_2.4.tar.gz and C-SDR\_2.4\_SPA\_2.4\_testdata.tar.gz (optional) files into the same directory.

Decompress and un-archive the C-SDR\_2.4\_SPA\_2.4.tar.gz and C-SDR\_2.4\_SPA\_2.4\_testdata.tar.gz (optional) files:

```
$ tar -xzf C-SDR_2.4_SPA_2.4.tar.gz  
$ tar -xzf C-SDR_2.4_SPA_2.4_testdata.tar.gz
```

This will create the following subdirectories:

```
SPA
  C-SDR
    algorithm
    ancillary
    mode
    station
    testdata
    testscripts
    wrapper
```

**Installing into an IPOPP Framework:** This SPA can also be installed dynamically into an IPOPP framework to automate production of ATMS SDR/TDR/Geolocation, CrIS SDR/Geolocation, CrIS FS SDR/Geolocation, and VIIRS SDR/Geolocation products. The SPA installation process will install SPA service(s) into IPOPP. An SPA service is an IPOPP agent that provides the mechanism necessary for running an SPA automatically within the IPOPP framework. Once this SPA is installed, users must enable the service(s) corresponding to this SPA along with any other prerequisite service(s). Instructions for installing an SPA and enabling its services are contained in the IPOPP User's Guide (available on the DRL Web Portal). The SPA services associated with this SPA are listed in Appendix A.

**NOTE:** IPOPP v2.6 requires the application of Patch 1 to enable JPSS-1 SPA services on the IPOPP Dashboard. IPOPP v2.6 Patch 1 is available for download at:

<https://directreadout.sci.gsfc.nasa.gov/?id=software>

## Software Package Testing and Validation

The testscripts subdirectory contains test scripts that can be used to verify that your current installation of the SPA is working properly, as described below. Note that the optional C-SDR\_2.4\_SPA\_2.4\_testdata.tar.gz file is required to execute these testing procedures.

*Step 1:* cd into the testscripts directory.

*Step 2:* There are scripts named inside the testscripts directory corresponding to each spacecraft and instrument.

To run the VIIRS SDR algorithm, use

```
$ ./run_SNPP_VIIRS_C-SDR_multi-granule.sh (for SNPP test data)
$ ./run_JPSS-1_VIIRS_C-SDR_multi-granule.sh (for JPSS-1 test data)
```

A successful execution usually requires 2 minutes or more, depending on the speed of your computer. If everything is working properly, the script will terminate with a message such as\*:

```
Output viirs.gdnbo is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/GDNBO_npp.h5
Output viirs.gimgo is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/GIMGO_npp.h5
Output viirs.gitco is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/GITCO_npp.h5
Output viirs.gmodo is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/GMODO_npp.h5
Output viirs.gmtco is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/GMTCO_npp.h5
```

```
Output viirs.icdbg is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/ICDBG_npp.h5
Output viirs.ivcldb is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/IVCDB_npp.h5
Output viirs.ivobc is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/IVOBC_npp.h5
Output viirs.svndb is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVNDNB_npp.h5
Output viirs.svi01 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVI01_npp.h5
Output viirs.svi02 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVI02_npp.h5
Output viirs.svi03 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVI03_npp.h5
Output viirs.svi04 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVI04_npp.h5
Output viirs.svi05 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVI05_npp.h5
Output viirs.svm01 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM01_npp.h5
Output viirs.svm02 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM02_npp.h5
Output viirs.svm03 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM03_npp.h5
Output viirs.svm04 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM04_npp.h5
Output viirs.svm05 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM05_npp.h5
Output viirs.svm06 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM06_npp.h5
Output viirs.svm07 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM07_npp.h5
Output viirs.svm08 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM08_npp.h5
Output viirs.svm09 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM09_npp.h5
Output viirs.svm10 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM10_npp.h5
Output viirs.svm11 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM11_npp.h5
Output viirs.svm12 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM12_npp.h5
Output viirs.svm13 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM13_npp.h5
Output viirs.svm14 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM14_npp.h5
Output viirs.svm15 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM15_npp.h5
Output viirs.svm16 is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SVM16_npp.h5
```

\*example above is for the SNPP test script; the JPSS-1 equivalent will output products ending in ".j01.h5"

Alternatively, to run the VIIRS SDR algorithm with cross-granule RDR inputs, use

```
$ ./run_SNPP_VIIRS_C-SDR_cross-granule.sh (for SNPP)
$ ./run_JPSS-1_VIIRS_C-SDR_cross-granule.sh (for JPSS-1)
```

A successful execution usually requires 2 minutes or more, depending on the speed of your computer. If everything is working properly, the script will terminate with a message such as\*:

```
Output viirs.gdnbo is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/GDNBO_npp.h5
Output viirs.gimgo is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/GIMGO_npp.h5
Output viirs.gitco is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/GITCO_npp.h5
Output viirs.gmODO is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/GMODO_npp.h5
Output viirs.gmtco is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/GMTCO_npp.h5
Output viirs.icdbg is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/ICDBG_npp.h5
Output viirs.ivcldb is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/IVCDB_npp.h5
Output viirs.ivobc is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/IVOBC_npp.h5
Output viirs.svndb is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVNDNB_npp.h5
Output viirs.svi01 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVI01_npp.h5
Output viirs.svi02 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVI02_npp.h5
Output viirs.svi03 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVI03_npp.h5
Output viirs.svi04 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVI04_npp.h5
Output viirs.svi05 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVI05_npp.h5
Output viirs.svm01 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM01_npp.h5
Output viirs.svm02 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM02_npp.h5
Output viirs.svm03 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM03_npp.h5
Output viirs.svm04 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM04_npp.h5
```

```
Output viirs.svm05 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM05_npp.h5
Output viirs.svm06 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM06_npp.h5
Output viirs.svm07 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM07_npp.h5
Output viirs.svm08 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM08_npp.h5
Output viirs.svm09 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM09_npp.h5
Output viirs.svm10 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM10_npp.h5
Output viirs.svm11 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM11_npp.h5
Output viirs.svm12 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM12_npp.h5
Output viirs.svm13 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM13_npp.h5
Output viirs.svm14 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM14_npp.h5
Output viirs.svm15 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM15_npp.h5
Output viirs.svm16 is /home/ipopp/SPA/C-SDR/testdata/output/cross-granule/SVM16_npp.h5
```

\*example above is for the SNPP test script; the JPSS-1 equivalent will output products ending in “\_j01.h5”

To run the ATMS SDR algorithm, use

```
$ ./run_SNPP_ATMS_C-SDR_multi-granule.sh (for SNPP)
$ ./run_JPSS-1_ATMS_C-SDR_multi-granule.sh (for JPSS-1)
```

A successful execution usually requires 1 minute or more, depending on the speed of your computer. If everything is working properly, the script will terminate with a message such as\*:

```
Output atms.fatms is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/FATMS_npp.h5
Output atms.gatmo is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/GATMO_npp.h5
Output atms.satms is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SATMS_npp.h5
Output atms.tatms is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/TATMS_npp.h5
```

\*example above is for the SNPP test script; the JPSS-1 equivalent will output products ending in “\_j01.h5”

To run the CrIS SDR algorithm, use

```
$ ./run_SNPP_CRIS_C-SDR_multi-granule.sh (for SNPP)
$ ./run_JPSS-1_CRIS_C-SDR_multi-granule.sh (for JPSS-1)
```

A successful execution usually requires 5 minutes or more, depending on the speed of your computer. If everything is working properly, the script will terminate with a message such as\*:

```
Output cris.gcrso is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/GCRSO_npp.h5
Output cris.rgcrs is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/RGCRS_npp.h5
Output cris.rgtrs is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/RGTRS_npp.h5
Output cris.scris is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SCRIS_npp.h5
```

\*example above is for the SNPP test script; the JPSS-1 equivalent will output products ending in “\_j01.h5”

Alternatively, to run the CrIS FS SDR algorithm, use

```
$ ./run_SNPP_C-SDR_CRIS-FS_multi-granule.sh (for SNPP)
$ ./run_JPSS-1_C-SDR_CRIS-FS_multi-granule.sh (for JPSS-1)
```

A successful execution usually requires 30 minutes or more, depending on the speed of your

computer. If everything is working properly, the script will terminate with a message such as\*:

```
Output cris.gcrso is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/GCRSO_FS_npp.h5  
Output cris.rgcrs is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/RGCRS_FS_npp.h5  
Output cris.rgtrs is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/RGTRS_FS_npp.h5  
Output cris.scris is /home/ipopp/SPA/C-SDR/testdata/output/multi-granule/SCRIF_npp.h5
```

\*example above is for the SNPP test script; the JPSS-1 equivalent will output products ending in “\_j01.h5”

You can cd to the output directory to verify that the science products exist. Test output product(s) are available for comparison in the testdata/output directory. These test output product(s) were generated on a 64-bit PC architecture computer running CentOS 7. The output products serve as an indicator of expected program output. Use a comparison utility (such as diff, h5diff, etc.) to compare your output product(s) to those provided in the testdata/output directory. Locally generated files may differ slightly from the provided output files because of differences in machine architecture or operating systems.

If there is a problem and the code terminates abnormally, the problem can be identified using the log files. Log files are automatically generated within the directory used for execution. They start with stdfile\* and errfile\*. Other log and intermediate files may be generated automatically within the directory used for execution. They are useful for traceability and debugging purposes. However it is strongly recommended that users clean up log files and intermediate files left behind in the run directory before initiating a fresh execution of the SPA. Intermediate files from a previous run may affect a successive run and produce ambiguous results. Please report any errors that cannot be fixed to the DRL.

## Program Operation

In order to run the package using your own input data, you can either use the run scripts within the wrapper subdirectories, or modify the test scripts within the testscripts subdirectory.

## To Use the Run Scripts

**Identify the 'run' scripts:** The wrapper directory within this package contains subdirectories named ATMS\_C-SDR, CRIS\_C-SDR, C-SDR\_CRIS-FS, and VIIRS\_C-SDR. The subdirectories contain an executable called 'run'. Execute 'run' within the correct wrapper subdirectory to generate the corresponding product. For instance, the 'run' within wrapper/VIIRS\_C-SDR is used for creating VIIRS SDR and Geolocation outputs. Note that to execute 'run', you need to have java on your path.

**Specify input parameters using <label value> pairs:** To execute the 'run' scripts, you must supply the required input and output parameters. Input and output parameters are usually file paths or other values. Each parameter is specified on the command line by a <label value> pair. Labels are simply predefined names for parameters. Each label must be followed by its actual value. Each process has its own set of <label value> pairs that must be specified in order for it to execute. Some of these pairs are optional, meaning the process would still be able to execute even if that parameter is not supplied. The types of <label value> pairs that the C-SDR\_SPA uses are:

- a) Input file label/values. These are input file paths. Values are absolute or relative paths to the corresponding input file.
- b) Output file label/values. These are output files that are produced by the SPA. Values are absolute or relative paths of the files you want to generate.
- c) Optional parameter label/values. These are parameters that may be optionally passed to the SPA (e.g., enabling/disabling terrain correction for VIIRS SDR).

This version of the C-SDR\_SPA provides an optional interface for cross-granule RDR file inputs to the VIIRS SDR algorithm. Use of cross-granule RDR file inputs improves processing at the granule boundaries of the dual-gain (M1 – M5, M7, M13) SDR output products. The granule start/end boundaries of the optional cross-granule RDR file inputs must be temporally adjacent (not overlapping) to the granule start/end boundaries of the primary RDR file input. The "previous" RDR file should be the one that is adjacent and precedes the first granule of the primary RDR file while the "next" RDR file should be the one that is adjacent and follows the last granule of the primary RDR file input.

To provide the optional cross-granule RDR file inputs, the files need to be specified as input parameters by using the optional ".prev" and ".next" file labels; the file label designated as ".prev" corresponds to the cross-granule RDR file that is temporally adjacent and precedes the first granule of the primary RDR file, and ".next" corresponds to the cross-granule RDR file that is temporally adjacent and follows the last granule of the primary RDR file.

The following tables contain labels, and their descriptions, required by the C-SDR\_SPA.

## VIIRS\_C-SDR

Input File Labels	Description	Source
viirs.rdr  Optional: viirs.rdr.prev viirs.rdr.next	VIIRS Raw Data Record (RDR) file	<ol style="list-style-type: none"> <li>Real-time SNPP VIIRS RDR products over the eastern US region are available from the DRL ftp site at: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcdata/npp/viirs/level0/RNSCA-RVIRS_npp_dyyyymmdd_thhmmssS_ehhmmssS*.h5">ftp://is.sci.gsfc.nasa.gov/gsfcdata/npp/viirs/level0/RNSCA-RVIRS_npp_dyyyymmdd_thhmmssS_ehhmmssS*.h5</a>            Where yyyy, mm, dd represents the year, month, and day of month for the start of the swath; the first hh, mm, ss, S represents the hour, minutes, seconds, and 10<sup>th</sup> of a second for the start of the swath and the second hh, mm, ss, S represents the end time of the swath.</li> <li>Real-time JPSS-1 VIIRS RDR products over the eastern US region are available from the DRL ftp site at: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcdata/jpss1/">ftp://is.sci.gsfc.nasa.gov/gsfcdata/jpss1/</a></li> </ol>

Input File Labels	Description	Source
		<p><a href="viirs/level0/RNSCA-RVIRS_j01_dyyyymmdd_thhmmssS_ehhmmssS*.h5">viirs/level0/RNSCA-RVIRS_j01_dyyyymmdd_thhmmssS_ehhmmssS*.h5</a></p> <p>Where yyyy, mm, dd represents the year, month, and day of month for the start of the swath; the first hh, mm, ss, S represents the hour, minutes, seconds, and 10<sup>th</sup> of a second for the start of the swath and the second hh, mm, ss, S represents the end time of the swath.</p> <p>3. VIIRS RDR products for other locations and times are available for download at: <a href="http://www.class.noaa.gov">www.class.noaa.gov</a></p>
tle	Two Line Element file	<p>For recent TLE files go to:  <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/ephemeris/tle/drl.tle.yyyyymmddhh">ftp://is.sci.gsfc.nasa.gov/ancillary/ephemeris/tle/drl.tle.yyyyymmddhh</a></p> <p>For archived TLE files go to:  <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/ephe_meris/tle/drl.tle.yyyyymmddhh">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/ephe_meris/tle/drl.tle.yyyyymmddhh</a></p> <p>Where yyyy, mm, dd, hh represents the year, month, day of month and hour for the tle ancillary file.</p>
polar	Polar Wander ancillary file	<p>DRL ftp site for Polar Wander files:  <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii">ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii</a></p> <p>Archived Polar Wander files:  <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/temp oral/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/temp oral/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii</a></p> <p>Where yyyy, mm, dd represents the year, month, and day for the polar wander ancillary file.</p>
sdr.lut (optional)	VIIRS Look Up Tables (LUTs) compressed tar file	<p>DRL ftp site for SNPP VIIRS LUTs:  <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/npp/viirs/ADL_5.3_I2_0_02/SNPP_VIIRS_ADL_LUT_dy yyymmdd_thhmmssS.tar.gz">ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/npp/viirs/ADL_5.3_I2_0_02/SNPP_VIIRS_ADL_LUT_dy yyymmdd_thhmmssS.tar.gz</a></p> <p>DRL ftp site for JPSS-1 VIIRS LUTs:  <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/jpss1/viirs/ADL_5.3_I2_0_02/JPSS-1_VIIRS_ADL_LUT_dy yyymmdd_thhmmssS.tar.gz">ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/jpss1/viirs/ADL_5.3_I2_0_02/JPSS-1_VIIRS_ADL_LUT_dy yyymmdd_thhmmssS.tar.gz</a></p> <p>Archived SNPP VIIRS LUTs:  <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUT">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUT</a></p>

<b>Input File Labels</b>	<b>Description</b>	<b>Source</b>
		<p><a href="s/npp/viirs/SNPP_VIIRS_AdL_LUT_dyymmdd_thmmssS.tar.gz">s/npp/viirs/SNPP_VIIRS_AdL_LUT_dyymmdd_thmmssS.tar.gz</a></p> <p>Archived JPSS-1 VIIRS LUTs:  <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUTs/jpss1/viirs/JPSS-1_VIIRS_AdL_LUT_dyymmdd_thmmssS.tar.gz">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUTs/jpss1/viirs/JPSS-1_VIIRS_AdL_LUT_dyymmdd_thmmssS.tar.gz</a></p> <p>Where yyyy, mm, dd represent the year, month, and day of month for the LUT files' effective date; the hh, mm, ss, S represent the hour, minutes, seconds, and 10<sup>th</sup> of a second for the LUT files' effective time.</p>
leapsec	Leapsec ancillary file	<p>DRL ftp site for leapsec files:  <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/leapsec.yyyymmddhh.dat">ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/leapsec.yyyymmddhh.dat</a></p> <p>Where yyyy, mm, dd, hh represents the year, month, day, and hour for the leapsec ancillary file.</p>

Output File Labels	Description	Output Format Description
viirs.gimgo	VIIRS I-Band Geolocation output HDF file path	
viirs.gitco	VIIRS I-Band Geolocation terrain-corrected output HDF file path	
viirs.gmodo	VIIRS M-Band Geolocation output HDF file path	
viirs.gmtco	VIIRS M-Band Geolocation terrain-corrected output HDF file path	
viirs.gdnbo	VIIRS Day/Night Band Geolocation output HDF file path	
viirs.icdbg	VIIRS M-Band Unaggregated Geolocation output HDF file path	
viirs.svdnb	VIIRS Day/Night Band SDR output HDF file path	
viirs.svixx {xx= 01 to 05}	VIIRS 375m Ix {x=01 to 05} Band SDR output HDF file path	
viirs.svmxx {xx= 01 to 16}	VIIRS 750m Mx {x=01 to 16} Band SDR output HDF file path	
viirs.ivobc	VIIRS On-board Calibrator IP output HDF file path	
viirs.ivcdb	VIIRS Calibrator Dual-Gain IP output HDF file path	

## ATMS\_C-SDR

Input File Labels	Description	Source
atms.rdr	ATMS Raw Data Record (RDR) file	<p>1. Real time SNPP ATMS RDR products over the eastern US region are available from the DRL ftp site at: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcdata/npp/atms/level0/RATMS-RNSCA_npp_dyyyymmdd_thhmmssS_ehhmmssS*.h5">ftp://is.sci.gsfc.nasa.gov/gsfcdata/npp/atms/level0/RATMS-RNSCA_npp_dyyyymmdd_thhmmssS_ehhmmssS*.h5</a></p> <p>Where yyyy, mm, dd represents the year, month, and day of month for the start of the swath; the first hh, mm, ss, S represents the hour, minutes, seconds, and 10<sup>th</sup> of a second for the start of the swath and the second hh, mm, ss, S</p>

Input File Labels	Description	Source
		<p>represents the end time of the swath.</p> <p>2. Real-time JPSS-1 ATMS RDR products over the eastern US region are available from the DRL ftp site at: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcdata/jpss1/atms/level0/RNSCA-RVIRS_j01_dyyyymmdd_thhmmssS_ehhmmssS*.h5">ftp://is.sci.gsfc.nasa.gov/gsfcdata/jpss1/atms/level0/RNSCA-RVIRS_j01_dyyyymmdd_thhmmssS_ehhmmssS*.h5</a></p> <p>Where yyyy, mm, dd represents the year, month, and day of month for the start of the swath; the first hh, mm, ss, S represents the hour, minutes, seconds, and 10<sup>th</sup> of a second for the start of the swath and the second hh, mm, ss, S represents the end time of the swath.</p> <p>3. ATMS RDR products for other locations and times are available for download at: <a href="http://www.class.noaa.gov">www.class.noaa.gov</a></p>
tle	Two Line Element file	<p>For recent TLE files go to: <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/ephemeris/tle/drl.tle.yyyyymmddhh">ftp://is.sci.gsfc.nasa.gov/ancillary/ephemeris/tle/drl.tle.yyyyymmddhh</a></p> <p>For archived TLE files go to: <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/ephe_meris/tle/drl.tle.yyyyymmddhh">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/ephe_meris/tle/drl.tle.yyyyymmddhh</a></p> <p>Where yyyy, mm, dd, hh represents the year, month, day of month and hour for the tle ancillary file.</p>
polar	Polar Wander ancillary file	<p>DRL ftp site for Polar Wander files: <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii">ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii</a></p> <p>Archived Polar Wander files: <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/temp oral/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/temp oral/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii</a></p> <p>Where yyyy, mm, dd represents the year, month, and day for the polar wander ancillary file.</p>
sdr.lut (optional)	ATMS Look Up Tables (LUTs) compressed tar file	<p>DRL ftp site for SNPP ATMS LUTs: <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/npp/atm s/ADL_5.3_I2_0_02/SNPP_ATMS_ADL_LUT_dyyyymmdd_thhmmssS.tar.gz">ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/npp/atm s/ADL_5.3_I2_0_02/SNPP_ATMS_ADL_LUT_dyyyymmdd_thhmmssS.tar.gz</a></p> <p>DRL ftp site for JPSS-1 ATMS LUTs: <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/jpss1/at ms/ADL_5.3_I2_0_02/JPSS-">ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/jpss1/at ms/ADL_5.3_I2_0_02/JPSS-</a></p>

<b>Input File Labels</b>	<b>Description</b>	<b>Source</b>
		<p>1_ATMS_ADL_LUT_dyymmdd_thhmmssS.tar.gz</p> <p>Archived SNPP ATMS LUTs:  <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUTs/npp/atms/SNPP_ATMS_ADL_LUT_dyymmdd_thhmmssS.tar.gz">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUTs/npp/atms/SNPP_ATMS_ADL_LUT_dyymmdd_thhmmssS.tar.gz</a></p> <p>Archived JPSS-1 ATMS LUTs:  <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUTs/jpss1/atms/JPSS-1_ATMS_ADL_LUT_dyymmdd_thhmmssS.tar.gz">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUTs/jpss1/atms/JPSS-1_ATMS_ADL_LUT_dyymmdd_thhmmssS.tar.gz</a></p> <p>Where yyyy, mm, dd represent the year, month, and day of month for the LUT files' effective date; the hh, mm, ss, S represent the hour, minutes, seconds, and 10<sup>th</sup> of a second for the LUT files' effective time.</p>
leapsec	Leapsec ancillary file	<p>DRL ftp site for leapsec files:  <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/leapsec.yyyymmddhh.dat">ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/leapsec.yyyymmddhh.dat</a></p> <p>Where yyyy, mm, dd, hh represents the year, month, day, and hour for the leapsec ancillary file.</p>

<b>Output File Labels</b>	<b>Description</b>	<b>Output Format Description</b>
atms.satms	ATMS SDR output HDF file path	Please refer to the JPSS Common Data Format Control Book (CDFCB) Volume III at: <a href="https://directreadout.sci.gsfc.nasa.gov/?id=dspContent&amp;cid=246">https://directreadout.sci.gsfc.nasa.gov/?id=dspContent&amp;cid=246</a>
atms.fatms	ATMS SDR (full-sized, floating-point version) output HDF file path	
atms.tatms	ATMS TDR output HDF file path	
atms.gatmo	ATMS Geolocation output HDF file path	

## CRIS\_C-SDR

<b>Input File Labels</b>	<b>Description</b>	<b>Source</b>
cris.rdr	CrIS Raw Data Record (RDR) file	<ol style="list-style-type: none"> <li>Real time SNPP CrIS RDR products over the eastern US region are available from the DRL ftp site at: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcdatal/npp/cris/level0/RCRIS-RNSCA_npp_dyymmdd_thhmmssS_ehhmmssS*.">ftp://is.sci.gsfc.nasa.gov/gsfcdatal/npp/cris/level0/RCRIS-RNSCA_npp_dyymmdd_thhmmssS_ehhmmssS*</a>.</li> </ol>

Input File Labels	Description	Source
		<p>h5</p> <p>Where yyyy, mm, dd represents the year, month, and day of month for the start of the swath; the first hh, mm, ss, S represents the hour, minutes, seconds, and 10<sup>th</sup> of a second for the start of the swath and the second hh, mm, ss, S represents the end time of the swath.</p> <p>2. Real-time JPSS-1 CrIS RDR products over the eastern US region are available from the DRL ftp site at: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcdata/jpss1/cris/level0/RNSCA-RVIRS_j01_dyyyymmdd_thhmmssS_ehhmmssS*.h5">ftp://is.sci.gsfc.nasa.gov/gsfcdata/jpss1/cris/level0/RNSCA-RVIRS_j01_dyyyymmdd_thhmmssS_ehhmmssS*.h5</a></p> <p>Where yyyy, mm, dd represents the year, month, and day of month for the start of the swath; the first hh, mm, ss, S represents the hour, minutes, seconds, and 10<sup>th</sup> of a second for the start of the swath and the second hh, mm, ss, S represents the end time of the swath.</p> <p>3. CrIS RDR products for other locations and times are available for download at: <a href="http://www.class.noaa.gov">www.class.noaa.gov</a></p>
tle	Two Line Element file	<p>For recent TLE files go to: <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/ephemeris/tle/drl.tle.yyyyymmddhh">ftp://is.sci.gsfc.nasa.gov/ancillary/ephemeris/tle/drl.tle.yyyyymmddhh</a></p> <p>For archived TLE files go to: <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/ephemeris/tle/drl.tle.yyyyymmddhh">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/ephemeris/tle/drl.tle.yyyyymmddhh</a></p> <p>Where yyyy, mm, dd, hh represents the year, month, day of month and hour for the tle ancillary file.</p>
polar	Polar Wander ancillary file	<p>DRL ftp site for Polar Wander files: <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii">ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii</a></p> <p>Archived Polar Wander files: <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/temporal/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/temporal/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii</a></p> <p>Where yyyy, mm, dd represents the year, month, and day for the polar wander ancillary file.</p>

<b>Input File Labels</b>	<b>Description</b>	<b>Source</b>
sdr.lut (optional)	CrIS Look Up Tables (LUTs) compressed tar file	<p>DRL ftp site for SNPP CrIS LUTs:  <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/npp/cris/ADL_5.3_I2_0_02/SNPP_CrIS_ADL_LUT_dyymmdd_thhmmssS.tar.gz">ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/npp/cris/ADL_5.3_I2_0_02/SNPP_CrIS_ADL_LUT_dyymmdd_thhmmssS.tar.gz</a></p> <p>DRL ftp site for JPSS-1 CrIS LUTs:  <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/jpss1/cris/ADL_5.3_I2_0_02/JPSS-1_CrIS_ADL_LUT_dyymmdd_thhmmssS.tar.gz">ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/jpss1/cris/ADL_5.3_I2_0_02/JPSS-1_CrIS_ADL_LUT_dyymmdd_thhmmssS.tar.gz</a></p> <p>Archived SNPP CrIS LUTs:  <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUTs/npp/cris/SNPP_CrIS_ADL_LUT_dyymmdd_thhmmssS.tar.gz">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUTs/npp/cris/SNPP_CrIS_ADL_LUT_dyymmdd_thhmmssS.tar.gz</a></p> <p>Archived JPSS-1 CrIS LUTs:  <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUTs/jpss1/cris/JPSS-1_CrIS_ADL_LUT_dyymmdd_thhmmssS.tar.gz">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUTs/jpss1/cris/JPSS-1_CrIS_ADL_LUT_dyymmdd_thhmmssS.tar.gz</a></p> <p>Where yyyy, mm, dd represent the year, month, and day of month for the LUT files' effective date; the hh, mm, ss, S represent the hour, minutes, seconds, and 10<sup>th</sup> of a second for the LUT files' effective time.</p>
leapsec	Leapsec ancillary file	<p>DRL ftp site for leapsec files:  <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/leapsec.yyyymmddhh.dat">ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/leapsec.yyyymmddhh.dat</a></p> <p>Where yyyy, mm, dd, hh represents the year, month, day, and hour for the leapsec ancillary file.</p>

<b>Output File Labels</b>	<b>Description</b>	<b>Output Format Description</b>
cris.scris	CrIS SDR output HDF file path	Please refer to the JPSS Common Data Format Control Book (CDFCB) Volume III at: <a href="https://directreadout.sci.gsfc.nasa.gov/?id=dspContent&amp;cid=246">https://directreadout.sci.gsfc.nasa.gov/?id=dspContent&amp;cid=246</a>
cris.gcrso	CrIS Geolocation output HDF file path	
cris.rgcrs	CrIS Geolocation (radians version) output HDF file path	
cris.rgtrs	CrIS Geolocation (radians and terrain-corrected version) output HDF file path	

## C-SDR\_CRIS-FS

Input File Labels	Description	Source
cris.rdr	CrIS Raw Data Record (RDR) file	<p>1. Real time SNPP CrIS RDR products over the eastern US region are available from the DRL ftp site at: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcdata/npp/cris/level0/RCRIS-RNSCA_npp_dyymmdd_thhmmssS_ehhmmssS*.h5">ftp://is.sci.gsfc.nasa.gov/gsfcdata/npp/cris/level0/RCRIS-RNSCA_npp_dyymmdd_thhmmssS_ehhmmssS*.h5</a> Where yyyy, mm, dd represents the year, month, and day of month for the start of the swath; the first hh, mm, ss, S represents the hour, minutes, seconds, and 10<sup>th</sup> of a second for the start of the swath and the second hh, mm, ss, S represents the end time of the swath.</p> <p>2. CrIS RDR products for other locations and times are available for download at: <a href="http://www.class.noaa.gov">www.class.noaa.gov</a></p>
tle	Two Line Element file	<p>For recent TLE files go to: <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/ephemeris/tle/drl.tle.yyyyymmddhh">ftp://is.sci.gsfc.nasa.gov/ancillary/ephemeris/tle/drl.tle.yyyyymmddhh</a></p> <p>For archived TLE files go to: <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/ephemeris/tle/drl.tle.yyyyymmddhh">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/ephemeris/tle/drl.tle.yyyyymmddhh</a></p> <p>Where yyyy, mm, dd, hh represents the year, month, day of month and hour for the tle ancillary file.</p>
polar	Polar Wander ancillary file	<p>DRL ftp site for Polar Wander files: <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii">ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii</a></p> <p>Archived Polar Wander files: <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/temporal/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/temporal/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_yyyyymmdd*.ascii</a></p> <p>Where yyyy, mm, dd represents the year, month, and day for the polar wander ancillary file.</p>
sdr.lut (optional)	CrIS Look Up Tables (LUTs) compressed tar file	<p>DRL ftp site for SNPP CrIS LUTs: <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/npp/cris/ADL_5.3_I2_0_02/SNPP_CrIS_ADL_LUT_dyymmdd_thhmmssS.tar.gz">ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/npp/cris/ADL_5.3_I2_0_02/SNPP_CrIS_ADL_LUT_dyymmdd_thhmmssS.tar.gz</a></p> <p>DRL ftp site for JPSS-1 CrIS LUTs:</p>

Input File Labels	Description	Source
		<p><a href="ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/jpss1/cris/ADL_5.3_I2_0_02/JPSS-1_CrIS_ADL_LUT_dyymmdd_thmmssS.tar.gz">ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/jpss1/cris/ADL_5.3_I2_0_02/JPSS-1_CrIS_ADL_LUT_dyymmdd_thmmssS.tar.gz</a></p> <p>Archived SNPP CrIS LUTs:  <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUTs/npp/cris/SNPP_CrIS_ADL_LUT_dyymmdd_thmmssS.tar.gz">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUTs/npp/cris/SNPP_CrIS_ADL_LUT_dyymmdd_thmmssS.tar.gz</a></p> <p>Archived JPSS-1 CrIS LUTs:  <a href="ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUTs/jpss1/cris/JPSS-1_CrIS_ADL_LUT_dyymmdd_thmmssS.tar.gz">ftp://is.sci.gsfc.nasa.gov/ArchivedAncillary/LUTs/jpss1/cris/JPSS-1_CrIS_ADL_LUT_dyymmdd_thmmssS.tar.gz</a></p> <p>Where yyyy, mm, dd represent the year, month, and day of month for the LUT files' effective date; the hh, mm, ss, S represent the hour, minutes, seconds, and 10<sup>th</sup> of a second for the LUT files' effective time.</p>
leapsec	Leapsec ancillary file	<p>DRL ftp site for leapsec files:  <a href="ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/leapsec.yyyymmddhh.dat">ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/leapsec.yyyymmddhh.dat</a></p> <p>Where yyyy, mm, dd, hh represents the year, month, day, and hour for the leapsec ancillary file.</p>

Output File Labels	Description	Output Format Description
cris.scrif	CrIS FS SDR output HDF file path	
cris.gcrso	CrIS Geolocation output HDF file path	Please refer to the JPSS Common Data Format Control Book (CDFCB) Volume III at: <a href="https://directreadout.sci.gsfc.nasa.gov/?id=dspContent&amp;cid=246">https://directreadout.sci.gsfc.nasa.gov/?id=dspContent&amp;cid=246</a>
cris.rgcrs	CrIS Geolocation (radians version) output HDF file path	
cris.rgtrs	CrIS Geolocation (radians and terrain-corrected version) output HDF file path	

**Execute the 'run':** The following script shows an example of a command line to run the VIIRS SDR algorithm from the testscripts directory:

```
$ ./wrapper/VIIRS_C-SDR/run \
viirs.rdr \
./testdata/input/RNSCA-RVIIRS_npp_d20170811_t1817210_e1818463_b29998_c20170825143546446158_nobu_ops.h5 \
viirs.gdnbo ./testdata/output/multi-granule/GDNBO_npp.h5 \
viirs.gimgo ./testdata/output/multi-granule/GIMGO_npp.h5 \
```

```

viirs.gitco ..../testdata/output/multi-granule/GITCO_npp.h5 \
viirs.gmodo ..../testdata/output/multi-granule/GMODO_npp.h5 \
viirs.gmtco ..../testdata/output/multi-granule/GMTCO_npp.h5 \
viirs.icdbg ..../testdata/output/multi-granule/ICDBG_npp.h5 \
viirs.ivcldb ..../testdata/output/multi-granule/IVCDB_npp.h5 \
viirs.ivobc ..../testdata/output/multi-granule/IVOBC_npp.h5 \
viirs.svndb ..../testdata/output/multi-granule/SVNDB_npp.h5 \
viirs.svi01 ..../testdata/output/multi-granule/SVI01_npp.h5 \
viirs.svi02 ..../testdata/output/multi-granule/SVI02_npp.h5 \
viirs.svi03 ..../testdata/output/multi-granule/SVI03_npp.h5 \
viirs.svi04 ..../testdata/output/multi-granule/SVI04_npp.h5 \
viirs.svi05 ..../testdata/output/multi-granule/SVI05_npp.h5 \
viirs.svm01 ..../testdata/output/multi-granule/SVM01_npp.h5 \
viirs.svm02 ..../testdata/output/multi-granule/SVM02_npp.h5 \
viirs.svm03 ..../testdata/output/multi-granule/SVM03_npp.h5 \
viirs.svm04 ..../testdata/output/multi-granule/SVM04_npp.h5 \
viirs.svm05 ..../testdata/output/multi-granule/SVM05_npp.h5 \
viirs.svm06 ..../testdata/output/multi-granule/SVM06_npp.h5 \
viirs.svm07 ..../testdata/output/multi-granule/SVM07_npp.h5 \
viirs.svm08 ..../testdata/output/multi-granule/SVM08_npp.h5 \
viirs.svm09 ..../testdata/output/multi-granule/SVM09_npp.h5 \
viirs.svm10 ..../testdata/output/multi-granule/SVM10_npp.h5 \
viirs.svm11 ..../testdata/output/multi-granule/SVM11_npp.h5 \
viirs.svm12 ..../testdata/output/multi-granule/SVM12_npp.h5 \
viirs.svm13 ..../testdata/output/multi-granule/SVM13_npp.h5 \
viirs.svm14 ..../testdata/output/multi-granule/SVM14_npp.h5 \
viirs.svm15 ..../testdata/output/multi-granule/SVM15_npp.h5 \
viirs.svm16 ..../testdata/output/multi-granule/SVM16_npp.h5 \
sdr.lut ..../testdata/input/SNPP_VIIRS_ADL_LUT_d20170811_t0000000.tar.gz \
tle ..../testdata/input/drl.tle.2017081113 \
polar ..../testdata/input/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_20170811_201708110000Z_20170811000503Z_ee20170818120000Z_np.ascii \
leapsec ..../testdata/input/leapsec.2017082500.dat

```

Alternatively, the following script shows an example of a command line to run the VIIRS SDR algorithm with cross-granule RDR inputs from the testscripts directory:

```

$ ..../wrapper/VIIRS_C-SDR/run \
viirs.rdr.prev \
..../testdata/input/RNSCA-RVIRS_npp_d20170811_t1815556_e1817210_b29998_c20170825143546446158_nobu_ops.h5 \
viirs.rdr \
..../testdata/input/RNSCA-RVIRS_npp_d20170811_t1817210_e1818463_b29998_c20170825143546446158_nobu_ops.h5 \
viirs.rdr.next \
..../testdata/input/RNSCA-RVIRS_npp_d20170811_t1818463_e1820117_b29998_c20170825143546446158_nobu_ops.h5 \
viirs.gdnbo ..../testdata/output/cross-granule/GDNBO_npp.h5 \
viirs.gimgo ..../testdata/output/cross-granule/GIMGO_npp.h5 \
viirs.gitco ..../testdata/output/cross-granule/GITCO_npp.h5 \
viirs.gmodo ..../testdata/output/cross-granule/GMODO_npp.h5 \
viirs.gmtco ..../testdata/output/cross-granule/GMTCO_npp.h5 \
viirs.icdbg ..../testdata/output/cross-granule/ICDBG_npp.h5 \
viirs.ivcldb ..../testdata/output/cross-granule/IVCDB_npp.h5 \
viirs.ivobc ..../testdata/output/cross-granule/IVOBC_npp.h5 \
viirs.svndb ..../testdata/output/cross-granule/SVNDB_npp.h5 \
viirs.svi01 ..../testdata/output/cross-granule/SVI01_npp.h5 \
viirs.svi02 ..../testdata/output/cross-granule/SVI02_npp.h5 \
viirs.svi03 ..../testdata/output/cross-granule/SVI03_npp.h5 \
viirs.svi04 ..../testdata/output/cross-granule/SVI04_npp.h5 \

```

```

viirs.svi05 ..../testdata/output/cross-granule/SVI05_npp.h5 \
viirs.svm01 ..../testdata/output/cross-granule/SVM01_npp.h5 \
viirs.svm02 ..../testdata/output/cross-granule/SVM02_npp.h5 \
viirs.svm03 ..../testdata/output/cross-granule/SVM03_npp.h5 \
viirs.svm04 ..../testdata/output/cross-granule/SVM04_npp.h5 \
viirs.svm05 ..../testdata/output/cross-granule/SVM05_npp.h5 \
viirs.svm06 ..../testdata/output/cross-granule/SVM06_npp.h5 \
viirs.svm07 ..../testdata/output/cross-granule/SVM07_npp.h5 \
viirs.svm08 ..../testdata/output/cross-granule/SVM08_npp.h5 \
viirs.svm09 ..../testdata/output/cross-granule/SVM09_npp.h5 \
viirs.svm10 ..../testdata/output/cross-granule/SVM10_npp.h5 \
viirs.svm11 ..../testdata/output/cross-granule/SVM11_npp.h5 \
viirs.svm12 ..../testdata/output/cross-granule/SVM12_npp.h5 \
viirs.svm13 ..../testdata/output/cross-granule/SVM13_npp.h5 \
viirs.svm14 ..../testdata/output/cross-granule/SVM14_npp.h5 \
viirs.svm15 ..../testdata/output/cross-granule/SVM15_npp.h5 \
viirs.svm16 ..../testdata/output/cross-granule/SVM16_npp.h5 \
sdr.lut ..../testdata/input/SNPP_VIIRS_ADL_LUT_d20170811_t0000000.tar.gz \
tle ..../testdata/input/drl.tle.2017081113 \
polar ..../testdata/input/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_20170811_201708110000Z_20170811000503Z_ee20170818120000Z_np.ascii \
leapsec ..../testdata/input/leapsec.2017082500.dat

```

The following script shows an example of a command line to run the ATMS SDR algorithm from the testscripts directory:

```

$ ./wrapper/ATMS_C-SDR/run \
atms.rdr \
..../testdata/input/RATMS-RNSCA_npp_d20170811_t1811533_e1819533_b29998_c20170812002001564987_nobu_ops.h5 \
atms.fatms ..../testdata/output/multi-granule/FATMS_npp.h5 \
atms.gatmo ..../testdata/output/multi-granule/GATMO_npp.h5 \
atms.satms ..../testdata/output/multi-granule/SATMS_npp.h5 \
atms.tatms ..../testdata/output/multi-granule/TATMS_npp.h5 \
sdr.lut ..../testdata/input/SNPP_ATMS_ADL_LUT_d20170811_t0000000.tar.gz \
tle ..../testdata/input/drl.tle.2017081113 \
polar ..../testdata/input/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_20170811_201708110000Z_20170811000503Z_ee20170818120000Z_np.ascii \
leapsec ..../testdata/input/leapsec.2017082500.dat

```

The following script shows an example of a command line to run the CrIS SDR algorithm from the testscripts directory:

```

$ ./wrapper/CRIS_C-SDR/run \
cris.rdr ..../testdata/input/RCRIS-RNSCA_npp_d20170811_t1811533_e1819533_b29998_c20170812002018084554_nobu_ops.h5 \
cris.gcrso ..../testdata/output/multi-granule/GCRSO_npp.h5 \
cris.rgcrs ..../testdata/output/multi-granule/RGCRS_npp.h5 \
cris.rgtrs ..../testdata/output/multi-granule/RGTRS_npp.h5 \
cris.scris ..../testdata/output/multi-granule/SCRIS_npp.h5 \
sdr.lut ..../testdata/input/SNPP_CrIS_ADL_LUT_d20170811_t0000000.tar.gz \
tle ..../testdata/input/drl.tle.2017081113 \
polar ..../testdata/input/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_20170811_201708110000Z_20170811000503Z_ee20170818120000Z_np.ascii \
leapsec ..../testdata/input/leapsec.2017082500.dat

```

The following script shows an example of a command line to run the CrIS FS SDR algorithm from the testscripts directory:

```
$ ./wrapper/C-SDR_CRIS-FS/run \
```

```

cris.rdr ..../testdata/input/RCRIS-RNSCA_npp_d20170811_t1811533_e1819533_b29998_c20170812002018084554_nobu_ops.h5 \
cris.gcrso ..../testdata/output/multi-granule/GCRSO_FS_npp.h5 \
cris.rgcrs ..../testdata/output/multi-granule/RGCRS_FS_npp.h5 \
cris.rgtrs ..../testdata/output/multi-granule/RGTRS_FS_npp.h5 \
cris.scrif ..../testdata/output/multi-granule/SCRIF_npp.h5 \
sdr.lut ..../testdata/input/SNPP_CrIS_ADL_LUT_d20170811_t0000000.tar.gz \
tle ..../testdata/input/drl.tle.2017081113 \
polar ..../testdata/input/off_USNO-PolarWander-UT1-ANC_Ser7_USNO_000f_20170811_201708110000Z_20170811000503Z_ee20170818120000Z_np.ascii \
leapsec ..../testdata/input/leapsec.2017082500.dat

```

A successful execution usually requires a few minutes or more, depending on the speed of your computer. Please note that the CrIS FS SDR algorithm takes considerably more time to complete processing compared to the other algorithms. If execution fails, you will see an error message indicating the cause of failure (e.g., a file cannot be found, or a label cannot be recognized). Correct it and run again. If the problem has some other cause, it can be identified using the log files. Log files are automatically generated within the directory used for execution. They start with stdfile\* and errfile\* and can be deleted after execution. Other log and intermediate files may be generated automatically within the directory used for execution. They are useful for traceability and debugging purposes. However it is strongly recommended that users clean up log files and intermediate files left behind in the run directory before initiating a fresh execution of the SPA. Intermediate files from a previous run may affect a successive run and produce ambiguous results. The 'run' can be executed from any directory the user chooses. This can be done by prefixing it with the file path for the 'run' script.

## **NOTES:**

1. The CrIS SDR and CrIS FS SDR algorithms generate the same types of Geolocation output products, namely "GCRSO", "RGCRS", and "RGTRS". Hence, in IPOPP mode their SPA services (CRIS\_C-SDR and CRIS-FS) must never be run simultaneously for the same spacecraft. For example:
  - a. 'CRIS\_C-SDR' and 'CRIS-FS' must never be run simultaneously for SNPP
  - b. 'CRIS\_C-SDR' and 'CRIS-FS' must never be run simultaneously for JPSS-1
2. Only CrIS RDRs starting from December 04, 2014 may be processed using the new \*C-SDR\_CRIS-FS SPA service, as that is the date CrIS was first switched into Full-Spectral mode on the SNPP spacecraft.
3. The JPSS-1 RDR test data packaged with this version of C-SDR are pre-launch proxy data recreated from SNPP data. Future releases of C-SDR\_SPA will include real JPSS-1 RDR test data once the spacecraft has launched and broadcasting live data.
4. The optional interface for cross-granule RDR file inputs for VIIRS\_C-SDR currently requires that all RDRs used are single-granule RDRs only (viirs.rdr.prev, viirs.rdr, viirs.rdr.next).
5. In order for the cross-granule RDR file inputs to be used in processing, both ".prev" and ".next" RDR files must be provided. An "all-or-nothing" approach is used in which both ".prev" and ".next" must be provided, or neither of them are used during processing.

6. The input ATMS RDR must have a minimum of 3 granules for successful ATMS SDR generation.
7. The input CrIS RDR must have a minimum of 9 granules for successful CrIS SDR and CrIS FS SDR generation.
8. The TLE file must be within 14 days of the input RDR file. Use the TLE closest to, but prior, to the date of the input RDR file. The TLE files provided by the DRL are time-stamped as follows: drl.tle.yyyymmddhh.
9. The Polar Wander file must be within 30 days of the input RDR file. Use the Polar Wander file closest to, but prior, to the date of the input RDR file. The Polar Wander files provided by the DRL are time-stamped as follows: off\_USNO-PolarWander-UT1-ANC\_Ser7\_USNO\_000f\_yyyymmdd\*.ascii
10. If the Big-Endian (BE) LUT collection set tar file is not provided in the command line, the SPA uses the default SDR BE LUT collection set included with this release. Use the SDR BE LUT collection set that is closest to, but prior, to the date of the input RDR file. The LUT collection sets are time-stamped as follows: {Satellite}\_{Sensor}-SDR\_BE\_LUTs\_yyyymmdd.tar.gz, where {Satellite} is 'NPP' or 'JPSS-1', and {Sensor} is 'VIIRS', 'CRIS', or 'ATMS'.
11. Leapsec ancillary files are cumulative. Use the latest leapsec file available regardless of the RDR date. The leapsec files provided by the DRL are time-stamped as follows: leapsec.yyyymmddhh.dat
12. The data products generated by this SPA may be visualized with the DRL's H2G\_SPA (Hierarchical Data Format [HDF] to Georeferenced Tagged Image File Format [GeoTIFF] Converter Science Processing Algorithm). H2G is designed specifically for Direct Readout applications to create geolocated GeoTIFF images, jpeg browse images, and png browse images for parameter datasets in SNPP products and EOS products. H2G\_SPA and its User's Guide are available for download from the DRL Web Portal. Please refer to Appendix A for information on enabling image production for this SPA in IPOPP.
13. If you have problems running the C-SDR SPA within IPOPP, make an entry in your /etc/hosts file for the Fully Qualified Domain Name (FQDN) of your IPOPP host machine. The instructions and example below assume that the name of the IPOPP host is ipopp\_host.sci.gsfc.nasa.gov, and that its IP address is 169.154.128.189.

```
# This command prints the FQDN of your host machine
$ hostname -f
ipoppp_host.sci.gsfc.nasa.gov
```

```
# This command prints the IP address of your host machine
$ hostname -i
169.154.128.189
```

```
# Add a line with the address and the FQDN to the end of your /etc/hosts file, like
this:
```

169.154.128.189 ipopp\_host.sci.gsfc.nasa.gov

### To Use the Scripts in the testscripts Directory

One simple way to run the algorithms from the directory of your choice using your own data is to copy the run\_\*.sh scripts from the testscripts directory to the selected directory. Change the values of the variables like WRAPPERHOME, INPUTHOME and OUTPUTHOME to reflect the file paths of the wrapper directories and the input/output file paths. Then modify the input/output file name variables. Run the script to process your data.

## Appendix A SPA Services

Installation of this SPA in IPOPP mode will make the SPA services listed in Table A-1 available to IPOPP. These services along with any other Prerequisite services (listed in Table A-2) will need to be enabled to allow IPOPP to automate production of the C-SDR\_SPA data products. Furthermore, users who wish to generate image products from the data products generated by this SPA will need to enable the image-generating services listed in Table A-3. The SPAs containing the Prerequisite and the image-generating services listed in Tables A-2 and A-3 can be downloaded from the DRL Web Portal, in case they are not already available in your IPOPP installation. Details about these other SPAs are available in the respective SPA User's Guides. Please refer to the IPOPP User's Guide for instructions on how to install an SPA in IPOPP and enable the corresponding services.

**Table A-1. SPA Services**

Services for this SPA	Data Products Produced	
	Product Name	Destination (when installed in IPOPP)
ATMS_C-SDR	ATMS SDR, TDR, and Geolocation Products	\$HOME/drl/data/pub/gsfcdatal/spacecraft/atms/level1/FA TMS_psn_dyymmdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup>  \$HOME/drl/data/pub/gsfcdatal/spacecraft/atms/level1/G ATMO_psn_dyymmdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup>  \$HOME/drl/data/pub/gsfcdatal/spacecraft/atms/level1/SA TMS_psn_dyymmdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup>  \$HOME/drl/data/pub/gsfcdatal/spacecraft/atms/level1/TA TMS_psn_dyymmdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup>
CRIS_C-SDR	CrIS SDR and Geolocation Products	\$HOME/drl/data/pub/gsfcdatal/spacecraft/cris/level1/GC RSO_psn_dyymmdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup>  \$HOME/drl/data/pub/gsfcdatal/spacecraft/cris/level1/RG CRS_psn_dyymmdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup>  \$HOME/drl/data/pub/gsfcdatal/spacecraft/cris/level1/RG TRS_psn_dyymmdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup>  \$HOME/drl/data/pub/gsfcdatal/spacecraft/cris/level1/SC RIS_psn_dyymmdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup>

CRIS-FS	<b>Product Name</b>	<b>Destination (when installed in IPOPP)</b>
	CRIS FS SDR and Geolocation Products	\$HOME/drl/data/pub/gsfcdatal/spacecraft/cris/level1/GC RSO_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup> \$HOME/drl/data/pub/gsfcdatal/spacecraft/cris/level1/RG CRS_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup> \$HOME/drl/data/pub/gsfcdatal/spacecraft/cris/level1/RG TRS_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup> \$HOME/drl/data/pub/gsfcdatal/spacecraft/cris/level1/SC RIF_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup>
VIIRS_C-SDR	<b>Product Name</b>	<b>Destination (when installed in IPOPP)</b>
	VIIRS SDR and Geolocation Products	\$HOME/drl/data/pub/gsfcdatal/spacecraft/viirs/level1/GD NBO_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup> \$HOME/drl/data/pub/gsfcdatal/spacecraft/viirs/level1/GI MGO_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup> \$HOME/drl/data/pub/gsfcdatal/spacecraft/viirs/level1/GIT CO_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup> \$HOME/drl/data/pub/gsfcdatal/spacecraft/viirs/level1/GM ODO_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup> \$HOME/drl/data/pub/gsfcdatal/spacecraft/viirs/level1/GM TCO_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup> \$HOME/drl/data/pub/gsfcdatal/spacecraft/viirs/level1/ICD BG_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup> \$HOME/drl/data/pub/gsfcdatal/spacecraft/viirs/level1/IVC DB_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup> \$HOME/drl/data/pub/gsfcdatal/spacecraft/viirs/level1/IVO BC_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup> \$HOME/drl/data/pub/gsfcdatal/spacecraft/viirs/level1/SV DNB_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup> \$HOME/drl/data/pub/gsfcdatal/spacecraft/viirs/level1/SVI {01-05}_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup> \$HOME/drl/data/pub/gsfcdatal/spacecraft/viirs/level1/SV M{01-16}_psn_dy yyymdd_thhmmssS_ehhmmssS*.h5 <sup>1</sup>

<sup>1</sup>. Where *spacecraft* represents the spacecraft name ('npp' or 'jpss1') and *psn* represents the spacecraft's platform short name ('npp' or 'j01'). The *yyyy*, *mm*, *dd*, represents the year, month and day of month for start of swath; the first *hh*, *mm*, *ss*, *S* represents the hour, minutes, seconds and 10th of a second for the start of swath and the second *hh*, *mm*, *ss*, *S* represents the end time of the swath.

**NOTE:** The services CRIS\_C-SDR and CRIS-FS must never be run simultaneously for the same spacecraft.

**Table A-2. Prerequisite Services**

Prerequisite SPA services	SPA in which they are available
N/A	N/A

**Table A-3. Image-generating Services**

Image-generating services	SPA in which they are available
vdnbright-geotiff	H2G_SPA
vdnbdy-geotiff	H2G_SPA
vtoatcolor-geotiff	H2G_SPA
vm12h5-geotiff	H2G_SPA
ATMS-SDR-geotiff	H2G_SPA
CrIS-SDR-geotiff	H2G_SPA

**NOTE:** Please refer to the H2G\_SPA User's Guide for more details about the image products, including their locations and filename patterns when they are generated in IPOPP.